

CLAIMS

What is claimed is:

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- 1 1. A roller cone drill bit comprising:
2 a plurality of arms;
3 rotatable cutting structures mounted on respective ones of said
4 arms; and
5 a plurality of teeth located on each of said cutting structures;
6 wherein approximately the same axial force is acting on each of
7 said cutting structure.
- 1 2. The roller cone drill bit of Claim 1, wherein the axial force on each
2 of said cutting structure is between thirty-one (31) percent and
3 thirty-five (35) percent of the total of the axial force on the bit.
- 1 3. A roller cone drill bit comprising:
2 a plurality of arms;
3 rotatable cutting structures mounted on respective ones of said
4 arms; and
5 a plurality of teeth located on each of said cutting structures;
6 wherein a substantially equal volume of formation is drilled by each
7 said cutting structure.
- 1 4. The roller cone drill bit of Claim 3, wherein the volume of
2 formation drilled by each of said cutting structures is between
3 thirty-one (31) percent and thirty-five (35) percent of the total
4 volume drilled by the drill bit.

- 1 5. A rotary drilling system, comprising:
2 a drill string which is connected to conduct drilling fluid from a
3 surface location to a rotary drill bit;
4 a rotary drive which rotates at least part of said drill string together
5 with said bit
6 said rotary drill bit comprising
7 a plurality of arms;
8 rotatable cutting structures mounted on respective ones of said
9 arms; and
10 a plurality of teeth located on each of said cutting structures;
11 wherein approximately the same axial force is acting on each of
12 said cutting structure.
- 1 6. A method of designing a roller cone drill bit, comprising the steps
2 of:
3 (a) calculating the volume of formation cut by each tooth on each
4 cutting structure;
5 (b) calculating the volume of formation cut by each cutting structure
6 per revolution of the drill bit;
7 (c) comparing the volume of formation cut by each of said cutting
8 structures with the volume of formation cut by all others of
9 said cutting structures of the bit;
10 (d) adjusting at least one geometric parameter on the design of at
11 least one cutting structure; and
12 (e) repeating steps (a) through (d) until substantially the same
13 volume of formation is cut by each of said cutting structures
14 of said bit.

1 7. The method of Claim 6, wherein the step of calculating the volume
2 of formation cut by each tooth on each cutting structure further
3 comprises the step of using numerical simulation to determine
4 the interval progression of each tooth as it intersects the
5 formation.

1 8. A method of designing a roller cone drill bit, the steps of
2 comprising:

- 3 (a) calculating the axial force acting on each tooth on each cutting
4 structure;
- 5 (b) calculating the axial force acting on each cutting structure per
6 revolution of the drill bit;
- 7 (c) comparing the axial force acting on each of said cutting
8 structures with the axial force on the other ones of said
9 cutting structures of the bit;
- 10 (d) adjusting at least one geometric parameter on the design of at
11 least one cutting structure;
- 12 (e) repeating steps (a) through (d) until approximately the same
13 axial force is acting on each cutting structure.

1 9. The method of Claim 8, wherein the step of calculating the normal
2 force acting on each tooth, on each cutting structure further
3 comprises the step of using numerical simulation to determine
4 the interval progression of each tooth as it intersects the
5 ~~formation.~~

